Development of characterization factors for metals in 7 EU water archetypes

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Title: Development of characterization factors for metals in 7 EU water archetypes

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Abstract:

Toxicity potential of most metals in the freshwater are estimated in current life cycle impact assessment (LCIA) models without taking the spatial differentiated speciation behavior of the metals into consideration. Using a novel approach developed by Gandhi and Diamond (Gandhi et al. 2010), new characterization factors (CF) representing freshwater ecotoxicity potentials are calculated for metals (e.g. Cr, Be and Ba) in 7 EU water types, taking into account the influence of speciation behavior on metal bioavailability and metal fate in seven different EU water types.

USEtox is used to model the fate of the metals, WHAM 7.0 is used to model the metal speciation, Kd values and bioavailability, while the Free Ion Activity Model (FIAM) is used to model the ecotoxicity effect. The resulting archetype-specific CFs show up to ~4 orders of magnitude difference for Cr and Be. This indicates that the toxicity potential of these two metals is strongly dependent on differences in water chemistry. In comparison, Ba shows a constant bioavailability ratio and toxicity effect across the modeled water chemistries. Thus CFs are strongly correlated with fate, which results in a more narrow range of CFs. The differences in water chemistry not only changes the absolute values of the CFs for the individual metals, but also their ranking in terms of freshwater ecotoxicity potential, illustrating the relevance of taking water chemistry into account when modeling metal ecotoxicity potential in LCIA. In order to support LCIA in the frequent situation where no information is available of the specific water type into which the metal emission occurs, site generic average factors are also calculated and different approaches to averaging across archetypes are investigated and discussed.

Key words: metal, characterization factor, life cycle impact assessment (LCIA), ecotoxicity

Awards: apply for Young Scientist Award

Reference:

Gandhi, N., M. L. Diamond, D. van de Meent, M. A. J. Huijbregts, Wjgm Peijnenburg, and J. Guinee. 2010. New Method for Calculating Comparative Toxicity Potential of Cationic Metals in Freshwater: Application to Copper, Nickel, and Zinc. Environmental Science & Technology 44 (13):5195-5201.